Citation:

Gibson S. Sugar-sweetened soft drinks and obesity: a systematic review of the evidence from observational studies and interventions. *Nutr Res Rev.* 2008 Dec;21(2):134-47.

PubMed ID: 19087367

Study Design:

Systematic Review

Class:

M - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the evidence from epidemiological studies and interventions regarding the association between sugar-containing drinks and body weight and obesity

Inclusion Criteria:

- Inclusion criteria were studies and reviews published in English up to July 2008 that related to consumption of sugar-containing drinks (SSD) and their association with body weight, BMI or adiposity in adults or children.
- All designs were included: cross-sectional, prospective, interventions and randomized controlled trials.

Exclusion Criteria:

Studies were excluded if they were animal studies, not published in English, gave no data on consumption of soft drinks or sweetened beverages, provided no anthropometric data, or were short-term experiments or mechanistic studies.

Description of Study Protocol:

Recruitment

- Results of a comprehensive review of the literature up to July 2008.
- Papers were identified from web-based searches in PubMed, Google Scholar and the Cochrane Library, supplemented by a hand-search of existing documentation and cross-references.
- All designs were included: cross-sectional, prospective, interventions and randomized controlled trials.

Design

Systematic review; Database searches up to July 2008 of Medline, Cochrane reviews, and Google scholar were conducted to examine the association of sugar-sweetened soft drinks (SSD) with body weight, BMI, or adiposity in adults or children. Search terms were 'soft drinks'/'sugar-sweetened beverages'/'-soda'/'liquid sugars' with 'weight'/'body weight'/'obesity'/'adiposity'. In addition, a hand search of cross-references was conducted.

Blinding used (if applicable): not applicable

Intervention (if applicable): not applicable

Statistical Analysis: not completed

Data Collection Summary:

Timing of Measurements

Studies range from 4 weeks to 9 years (longitudinal and intervention studies only)

Dependent Variables

- BMI, body weight, BMI z score

Independent Variables

- Sugar-sweetened soft drinks (SSD) consumption: SSD were defined as all cold beverages containing added sugars, whether carbonated or still, including soda pop and fruit squash and drinks with a fruit component less than 100% pure fruit juice; hot beverages and diet drinks were not included.

Control Variables

Description of Actual Data Sample:

Initial N:

A total of forty-four original studies, forty were observational (twenty-three cross-sectional and seventeen prospective) and four were interventions. Three of the prospective studies also provided cross-sectional data at baseline.

- Cross sectional studies included 43 - 137,000 (adults and children)
- Longitudinal studies included 21 - 17,369 subjects (adults and children)
- Intervention trials included 41 - 1140 subjects

Attrition (final N): as above

Age:

- Cross sectional studies included subjects aged 1 - 74 years (adults and children)
- Longitudinal studies included subjects aged 2 - 19 years (adults)
- Intervention studies included adults and children aged 7 - 18 years

Ethnicity: not reported

Other relevant demographics

Anthropometrics

Location: 34 countries, North America, South America, Europe

Summary of Results:

Key Findings

- Approximately half the cross-sectional and prospective studies found a statistically significant association between SSD consumption and BMI, weight, adiposity or weight gain in at least one subgroup.

- The totality of evidence is dominated by American studies where SSD consumption tends to be higher and formulations different.
- Most studies suggest that the effect of SSD is small except in susceptible individuals or at high levels of intake.
- Methodological weaknesses mean that many studies cannot detect whether soft drinks or other aspects of diet and lifestyle have contributed to excess body weight.
- Progress in reaching a definitive conclusion on the role of SSD in obesity is hampered by the paucity of good-quality interventions which reliably monitor diet and lifestyle and adequately report effect sizes.
- Of the three long-term interventions, one reported a decrease in obesity prevalence but no change in mean BMI and two found a significant impact only among children already overweight at baseline.
- Of the six reviews, two concluded that the evidence was strong, one that an association was probable, while three described it as inconclusive, equivocal or near zero.
- Results were equivocal, with less than half of the studies with cross-sectional data (n =12/27) showing a significant positive association between SSD and BMI or overweight inat least one group.
- The majority of studies on children and youth derive from the USA, where consumption of SSD is typically about twice that of UK and Europe (8–10% of energy v. 4–5 %).
- Positive associations of SSD with weight status may be more likely in populations with high intakes, including some ethnic groups.
- For the 11 studies with adults:
    - 3 cross-sectional studies showed a significant positive association between SSD and obesity; 1 cross-sectional study showed no association between SSD and BMI
    - 3 longitudinal studies showed a positive association between SSD and BMI in at least one subgroup; 1 longitudinal study showed a positive, but non-significant, association with BMI; 2 longitudinal studies showed no association with BMI
    - 1 intervention study showed a positive associatin with body weight
- Thirteen studies showed no association between SSD and BMI, of which twelve were in children.
- The majority of cross-sectional studies do not support a positive association of BMI with SSD.
- Of the seventeen longitudinal studies included, half (eight) showed a significant positive association between SSD consumption and weight or weight gain in at least one subgroup.
- About half of the longitudinal studies show a significant positive result but the effect appears small.
- Problems remain in assessing the independent effect of SSD, due to potential confounding from other diet and lifestyle factors.
- Three studies in the present review provide limited evidence that avoidance of sugar-containing soft drinks or substitution with other lower-energy beverages may help prevent further weight gain in overweight individuals.

Author Conclusion:

- SSD are by nature a source of energy but there is little evidence from epidemiological studies that they are more obesogenic than any other source of energy.
- The recommendation that SSD are a disproportionate cause of excess body weight and/or that their avoidance would be effective in preventing weight gain are not well substantiated by the science.
- The inconsistencies of definition, design, statistical treatment and interpretation make it difficult to draw definitive conclusions as to whether sugar-sweetened beverages are significantly implicated in weight gain.
  (1) Insufficient long-term interventions;
  (2) Differing definitions of SSD and terminology;
  (3) Differing units for serving size and frequency;
  (4) Unreliable methods for dietary assessment;
  (5) Narrow focus on SSD with inadequate assessment of other diet components or energy;
  (6) Weight and height self-reported, not measured;
  (7) Poor or no measurement of physical activity;
  (8) Inadequate exploration of confounders or effect modifiers in analysis (for example, baseline BMI, ethnicity, baseline diet, misreporting);
  (9) Inconsistent evidence between subgroups;
  (10) Underpowered studies, no conclusions can be drawn;
  (11) Possibility of publication bias towards positive studies.
- The totality of evidence is dominated by American studies that may be less applicable to the European context where consumption is substantially lower and composition or formulation may differ (high fructose corn syrup v. sucrose, proportion of diet v. non-diet, etc).
- Most studies suggest that the effect of SSD on body weight is small except in susceptible individuals or at high levels of intake.
- Methodological weaknesses mean that many studies cannot detect whether SSD or other aspects of diet and lifestyle have contributed to excess body weight or weight change.
- Meta-analysis provides a way to quantify effect sizes to provide sufficient statistical detail on outcomes and exposures, in subgroups as well as the total sample, and on the effects of adjusting for confounding variables.
- More intervention studies are required, especially among overweight consumers of SSD, but these should use reliable measurements of diet and physical activity and have adequate length of follow-up.
- New trials are due to report soon; therefore ongoing review of this area is imperative.

Reviewer Comments:

- *The review included both adults and children and no significant differentiation of gender and age groups. Inclusion criteria does not include the BMI cut off criteria.*
- *No baseline demographic information on subject characteristics in these studies. In the intervention studies there is no description of baseline and final characteristics of the subjects. Other demographic and etiological factors may influence the results.*

Research Design and Implementation Criteria Checklist: Review Articles

Relevance Questions		
1.	Will the answer if true, have a direct bearing on the health of patients?	Yes
2.	Is the outcome or topic something that patients/clients/population groups would care about?	Yes
3.	Is the problem addressed in the review one that is relevant to nutrition or dietetics practice?	Yes
4.	Will the information, if true, require a change in practice?	Yes

Validity Questions		
1.	Was the question for the review clearly focused and appropriate?	Yes
2.	Was the search strategy used to locate relevant studies comprehensive? Were the databases searched and the search termsused described?	Yes
3.	Were explicit methods used to select studies to include in the review? Were inclusion/exclusion criteria specified and appropriate? Were selection methods unbiased?	???
4.	Was there an appraisal of the quality and validity of studies included in the review? Were appraisal methods specified, appropriate, and reproducible?	Yes
5.	Were specific treatments/interventions/exposures described? Were treatments similar enough to be combined?	Yes
6.	Was the outcome of interest clearly indicated? Were other potential harms and benefits considered?	Yes
7.	Were processes for data abstraction, synthesis, and analysis described? Were they applied consistently across studies and groups? Was there appropriate use of qualitative and/or quantitative synthesis? Was variation in findings among studies analyzed? Were heterogeneity issued considered? If data from studies were aggregated for meta-analysis, was the procedure described?	Yes
8.	Are the results clearly presented in narrative and/or quantitative terms? If summary statistics are used, are levels of significance and/or confidence intervals included?	Yes
9.	Are conclusions supported by results with biases and limitations taken into consideration? Are limitations of the review identified and discussed?	???
10.	Was bias due to the review's funding or sponsorship unlikely?	???